CLAIMS

1. An optical path switching device, comprising:

a light absorption layer film arranged such that at least a control light focuses on the light absorption layer film;

means for converging and irradiating on the light absorption layer film each of a control light having a wavelength selected from a wavelength band which is absorbed by the light absorption layer film and a signal light having a wavelength selected from a wavelength band which is not absorbed by the light absorption layer film;

a thermal lens forming element including the light absorption layer film, wherein a thermal lens is reversibly formed according to a distribution of refraction index created by a temperature increase generated in and around an area of the light absorption layer film in which the control light is absorbed, such that, according to whether or not the control light is irradiated, the converged signal light is output either as is in its converged form or after its spread angle is changed; and

a mirror including a hole and reflecting means, wherein, according to whether or not the control light is irradiated, the signal light output from the thermal lens forming element is either passed through the hole or reflected by the reflecting means to change the optical path.

2. An optical path switching device, comprising:

a light absorption layer film arranged such that at least a control light focuses on the light absorption layer film;

means for converging and irradiating on the light absorption layer film each of a control light having a wavelength selected from a wavelength band which is absorbed by the light absorption layer film and a signal light having a wavelength selected from a wavelength band which is not absorbed by the light absorption layer film;

a thermal lens forming element including the light absorption layer film, wherein a thermal lens is reversibly formed according to a distribution of refraction index created by a temperature increase generated in and around an area of the light absorption layer film in which the control light is absorbed, such that, when the control light is not irradiated and the thermal lens is not formed, the converged signal light is output while spreading at a normal spread angle, and, when the control light is irradiated and the thermal lens is formed in the vicinity of an incident surface of the light absorption layer film, the converged signal light is output while spreading at a spread angle greater than the normal spread angle, thereby allowing the spread angle of the output signal light to be changed according to whether or not the control light is irradiated; and

a mirror for changing the optical path, including a hole through which passes, when the control light is not irradiated and the thermal lens is not formed, the signal light output from the thermal lens forming element at the normal spread angle as is or after the spread angle is changed by a receiver lens, and means for reflecting, when the control light is irradiated and the thermal lens is formed in the vicinity of an incident surface of the light absorption layer film, the signal light output from the thermal lens forming element while spreading at the spread angle greater than the normal spread

angle as is or after the spread angle is changed by the receiver lens.

3. An optical path switching device, comprising:

a light absorption layer film arranged such that at least a control light focuses on the light absorption layer film;

means for converging and irradiating on the light absorption layer film each of a control light having a wavelength selected from a wavelength band which is absorbed by the light absorption layer film and a signal light having a wavelength selected from a wavelength band which is not absorbed by the light absorption layer film;

a thermal lens forming element including the light absorption layer film, wherein a thermal lens is reversibly formed according to a distribution of refraction index created by a temperature increase generated in and around an area of the light absorption layer film in which the control light is absorbed, such that, when the control light is irradiated and the thermal lens is formed in the vicinity of an output surface of the light absorption layer film, the converged signal light is output as converged, and, when the control light is not irradiated and the thermal lens is not formed, the converged signal light is output at a normal spread angle, thereby allowing the spread angle of the output signal light to be changed according to whether or not the control light is irradiated; and

a mirror for changing the optical path, including a hole through which passes, when the control light is irradiated and the thermal lens is formed in the vicinity of an output surface of the light absorption layer film, the converged signal light output from the thermal lens forming element, and means for reflecting, when the control

light is not irradiated and the thermal lens is not formed, the signal light output from the thermal lens forming element at the normal spread angle as is or after being passed through a receiver lens provided for changing the spread angle.

4. An optical path switching device as defined in Claim 2, wherein the thermal lens forming element is composed of laminated films.

5. An optical path switching device as defined in Claim 3, wherein the thermal lens forming element is composed of laminated films.

6. An optical path switching device as defined in Claim 2, wherein a thickness of the light absorption layer film does not exceed double a confocal distance of the converged control light.

7. An optical path switching device as defined in Claim 3, wherein a thickness of the light absorption layer film does not exceed double a confocal distance of the converged control light.

8. An optical path switching device as defined in Claim 2, wherein one or both of a concentration of a light-absorbing component in the light absorption layer film or a thickness of a light absorption film included in the light absorption layer film are controlled such that a transmittance of the control light propagating through the light absorption layer film within the thermal lens forming element is in a range between 90% and 0%, and a transmittance of the signal light propagating through the light absorption layer film within the thermal

lens forming element is in a range between 10% and approximately 100% when the control light is not irradiated.

9. An optical path switching device as defined in Claim 3, wherein one or both of a concentration of a light-absorbing component in the light absorption layer film or a thickness of a light absorption film included in the light absorption layer film are controlled such that a transmittance of the control light propagating through the light absorption layer film within the thermal lens forming element is in a range between 90% and 0%, and a transmittance of the signal light propagating through the light absorption layer film within the thermal lens forming element is in a range between 10% and approximately 100% when the control light is not irradiated.

10. An optical path switching device as defined in Claim 2, wherein

the light absorption layer film includes a thermal lens forming layer;

the thermal lens forming layer is composed of a liquid crystal; and

the liquid crystal comprises at least one type of liquid crystal selected from a group consisting of various cholesterol derivatives, 4′-n-alkoxybenzylidene-4-cyanoanilines, 4′-alkoxybenzylideneanilines, 4′-cyanobenzylidene-4-alkoxyanilines, carbonic esters, 4′-alkoxyphenyl 4-alkylbenzoates, azoxybenzene derivatives, 4-cyano-4′-alkylbiphenyls, and ferroelectric liquid crystals including 4′,4″-octyloxybiphenyl

(2S,3S)-3-methyl-2-chloropentanoate, 4-hexyloxyphenyl 4′-(2-methylbutyl)biphenyl-4-carboxylate, and 4-(2-methylbutyl)phenyl 4′-octylbiphenyl-4-carboxylate.

11. An optical path switching device as defined in Claim 3, wherein

the light absorption layer film includes a thermal lens forming layer;

the thermal lens forming layer is composed of a liquid crystal; and

the liquid crystal comprises at least one type of liquid crystal selected from a group consisting of various cholesterol derivatives, 4′-n-alkoxybenzylidene-4-cyanoanilines, 4′-alkoxybenzylideneanilines, 4′-cyanobenzylidene-4-alkoxyanilines, carbonic esters, 4′-alkoxyphenyl 4-alkylbenzoates, azoxybenzene derivatives, 4-cyano-4′-alkylbiphenyls, and ferroelectric liquid crystals including 4′,4″-octyloxybiphenyl (2S,3S)-3-methyl-2-chloropentanoate, 4-hexyloxyphenyl 4′-(2-methylbutyl)biphenyl-4-carboxylate, and 4-(2-methylbutyl)phenyl 4′-octylbiphenyl-4-carboxylate.

12. An optical path switching device as defined in Claim 2, wherein the means for irradiating controls beam cross-sectional shape and size of each of the signal and control lights such that a beam cross-section of the signal light in the vicinity of its beam waist having the highest photon density does not exceed a beam cross-section of the control light at its beam waist.

13. An optical path switching device as defined in Claim 3, wherein the means for irradiating controls beam cross-sectional shape and size of each of the signal and control lights such that a beam cross-section of the signal light in the vicinity of its beam waist having the highest photon density does not exceed a beam cross-section of the control light at its beam waist.

14. An optical path switching device as defined in Claim 2, wherein

the means for converging and irradiating each of the control and signal lights is a condenser lens; and

a numerical aperture of the receiver lens is no less than double a numerical aperture of the condenser lens.

15. An optical path switching device as defined in Claim 3, wherein

the means for converging and irradiating each of the control and signal lights is a condenser lens; and

a numerical aperture of the receiver lens is no less than double a numerical aperture of the condenser lens.

16. An optical path switching method, comprising:

converging and irradiating, on a light absorption layer film provided in a thermal lens forming element including at least the light absorption layer film, each of a control light having a wavelength selected from a wavelength band which is absorbed by the light absorption layer film and a signal light having a wavelength selected from a wavelength band which is not absorbed by the light absorption layer

film, while adjusting an arrangement of the light absorption layer film such that at least the control light focuses within the light absorption layer film, thereby allowing a thermal lens to be reversibly formed according to a distribution of refraction index created by a temperature increase generated in and around an area of the light absorption layer film in which the control light is absorbed, such that, according to whether or not the control light is irradiated, the converged signal light is output either as is in its converged form or after its spread angle is changed; and

using a mirror including a hole and reflecting means so as to, according to whether or not the control light is irradiated, allow the signal light output from the thermal lens forming element to be either passed through the hole or reflected by the reflecting means to change the optical path.

17. An optical path switching method, comprising:

converging and irradiating, on a light absorption layer film provided in a thermal lens forming element including at least the light absorption layer film, each of a control light having a wavelength selected from a wavelength band which is absorbed by the light absorption layer film and a signal light having a wavelength selected from a wavelength band which is not absorbed by the light absorption layer film, while adjusting an arrangement of the light absorption layer film such that at least the control light focuses within the light absorption layer film, thereby allowing a thermal lens to be reversibly formed according to a distribution of refraction index created by a temperature increase generated in and around an area of the light

absorption layer film in which the control light is absorbed, such that, when the control light is not irradiated and the thermal lens is not formed, the converged signal light is output from the thermal lens forming element while spreading at a normal spread angle, and, when the control light is irradiated and the thermal lens is formed in the vicinity of an incident surface of the light absorption layer film, the converged signal light is output from the thermal lens forming element while spreading at a spread angle greater than the normal spread angle, thereby changing the spread angle of the output signal light according to whether or not the control light is irradiated;

when the control light is not irradiated and the thermal lens is not formed, allowing the signal light output from the thermal lens forming element at the normal spread angle to pass, as is or after the spread angle is changed by a receiver lens, through a hole in a mirror and proceed along a straight path; and

when the control light is irradiated and the thermal lens is formed in the vicinity of an incident surface of the light absorption layer film, allowing the signal light output from the thermal lens forming element while spreading at the spread angle greater than the normal spread angle to be, as is or after the spread angle is changed by the receiver lens, reflected using a reflection surface of the mirror to change optical path.

18. An optical path switching method, comprising:

converging and irradiating, on a light absorption layer film provided in a thermal lens forming element including at least the light absorption layer film, each of a control light having a wavelength

selected from a wavelength band which is absorbed by the light absorption layer film and a signal light having a wavelength selected from a wavelength band which is not absorbed by the light absorption layer film, while adjusting an arrangement of the light absorption layer film such that at least the control light focuses within the light absorption layer film, thereby allowing a thermal lens to be reversibly formed according to a distribution of refraction index created by a temperature increase generated in and around an area of the light absorption layer film in which the control light is absorbed, such that, when the control light is irradiated and the thermal lens is formed in the vicinity of an output surface of the light absorption layer film, the converged signal light is output from the thermal lens forming element as converged, and, when the control light is not irradiated and the thermal lens is not formed, the converged signal light is output from the thermal lens forming element at a normal spread angle, thereby changing the spread angle of the output signal light according to whether or not the control light is irradiated;

when the control light is irradiated and the thermal lens is formed in the vicinity of the output surface of the light absorption layer film, allowing the converged signal light output from the thermal lens forming element pass through a hole in a mirror and proceed along a straight path; and

when the control light is not irradiated and the thermal lens is not formed, allowing the signal light output from the thermal lens forming element at the normal spread angle to be, as is or after the spread angle is changed by a receiver lens, reflected using a reflection surface of the mirror to change optical path.

19. An optical path switching method as defined in Claim 17, wherein the thermal lens forming element is composed of laminated films.

20. An optical path switching method as defined in Claim 18, wherein the thermal lens forming element is composed of laminated films.

21. An optical path switching method as defined in Claim 17, wherein a thickness of the light absorption layer film does not exceed double a confocal distance of the converged control light.

22. An optical path switching method as defined in Claim 18, wherein a thickness of the light absorption layer film does not exceed double a confocal distance of the converged control light.

23. An optical path switching method as defined in Claim 17, wherein one or both of a concentration of a light-absorbing component in the light absorption layer film or a thickness of a light absorption film included in the light absorption layer film are controlled such that a transmittance of the control light propagating through the light absorption layer film within the thermal lens forming element is in a range between 90% and 0%, and a transmittance of the signal light propagating through the light absorption layer film within the thermal lens forming element is in a range between 10% and approximately 100% when the control light is not irradiated.

24. An optical path switching method as defined in Claim 18, wherein one or both of a concentration of a light-absorbing component in the light absorption layer film or a thickness of a light absorption film included in the light absorption layer film are controlled such that a transmittance of the control light propagating through the light absorption layer film within the thermal lens forming element is in a range between 90% and 0%, and a transmittance of the signal light propagating through the light absorption layer film within the thermal lens forming element is in a range between 10% and approximately 100% when the control light is not irradiated.

25. An optical path switching method as defined in Claim 17, wherein

the light absorption layer film includes a thermal lens forming layer;

the thermal lens forming layer is composed of a liquid crystal; and

the liquid crystal comprises at least one type of liquid crystal selected from a group consisting of various cholesterol derivatives, 4′-n-alkoxybenzylidene-4-cyanoanilines, 4′-alkoxybenzylideneanilines, 4′-cyanobenzylidene-4-alkoxyanilines, carbonic esters, 4′-alkoxyphenyl 4-alkylbenzoates, azoxybenzene derivatives, 4-cyano-4′-alkylbiphenyls, and ferroelectric liquid crystals including 4′,4″-octyloxybiphenyl (2S,3S)-3-methyl-2-chloropentanoate, 4-hexyloxyphenyl

4′-(2-methylbutyl)biphenyl-4-carboxylate, and 4-(2-methylbutyl)phenyl 4′-octylbiphenyl-4-carboxylate.

26. An optical path switching method as defined in Claim 18, wherein

the light absorption layer film includes a thermal lens forming layer;

the thermal lens forming layer is composed of a liquid crystal; and

the liquid crystal comprises at least one type of liquid crystal selected from a group consisting of various cholesterol derivatives, 4′-n-alkoxybenzylidene-4-cyanoanilines, 4′-alkoxybenzylideneanilines, 4′-cyanobenzylidene-4-alkoxyanilines, carbonic esters, 4′-alkoxyphenyl 4-alkylbenzoates, azoxybenzene derivatives, 4-cyano-4′-alkylbiphenyls, and ferroelectric liquid crystals including 4′,4″-octyloxybiphenyl (2S,3S)-3-methyl-2-chloropentanoate, 4-hexyloxyphenyl 4′-(2-methylbutyl)biphenyl-4-carboxylate, and 4-(2-methylbutyl)phenyl 4′-octylbiphenyl-4-carboxylate.

27. An optical path switching method as defined in Claim 17, wherein when the signal and control lights irradiate, controlling beam cross-sectional shape and size of each of the signal and control lights such that a beam cross-section of the signal light in the vicinity of its beam waist having the highest photon density does not exceed a beam cross-section of the control light at its beam waist.

28. An optical path switching method as defined in Claim 18, wherein when the signal and control lights irradiate, controlling beam cross-sectional shape and size of each of the signal and control lights such that a beam cross-section of the signal light in the vicinity of its beam waist having the highest photon density does not exceed a beam cross-section of the control light at its beam waist.

29. An optical path switching method as defined in Claim 17, wherein

the means for converging and irradiating each of the control and signal lights is a condenser lens; and

a numerical aperture of the receiver lens is no less than double a numerical aperture of the condenser lens.

30. An optical path switching method as defined in Claim 18, wherein

the means for converging and irradiating each of the control and signal lights is a condenser lens; and

a numerical aperture of the receiver lens is no less than double a numerical aperture of the condenser lens.